Methane Pyrolysis for Hydrogen & Carbon Nanotube Recovery from Sabatier Products, Phase I

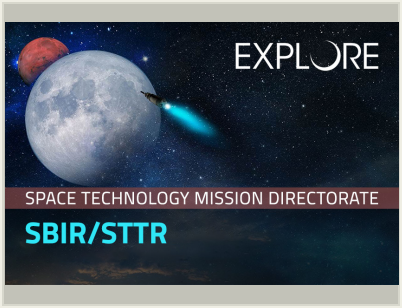
Completed Technology Project (2005 - 2005)

Project Introduction

Development of a microgravity and hypogravity compatible catalytic methane pyrolysis reactor is proposed to recover hydrogen which is lost as methane in the conversion of carbon dioxide to water via the Sabatier process. This will close the hydrogen loop which currently requires 50% resupply and also produce carbon nanotubes, a high value product which may be employed as an adsorbent or catalyst for removal of atmospheric trace contaminants, thus further lowering the resupply burden for manned spacecraft. Microgravity compatibility of Gradient Magnetically Assisted Fluidized Beds (GMAFB) has been demonstrated through a series of KC135 flight experiments. Metallic cobalt, which has been fluidized in microgravity using the GMAFB method, is an excellent catalyst for promotion of methane pyrolysis. Recently, fluidized bed catalytic methods have been shown to efficiently recover hydrogen, and produce single walled carbon nanotubes. Using the GMAFB method, this process can be rendered totally compatible with operation in the microgravity of spaceflight or the reduced gravity of planetary environments. By recovering all of the hydrogen which is lost as methane in the Sabatier reactor, the requirement for production or resupply of hydrogen is reduced to the absolute minimum.

Anticipated Benefits

Production of carbon nanotubes is an area with extremely high economic potential. Numerous potential applications for these materials, include: nanometer sized semiconductor components and devices, field emission displays, hydrogen storage, sensors, energy storage and energy conversion devices, catalysts, and conductive and high strength composites. Carbon nanotubes, are extremely valuable products for which there are currently no efficient methods of high volume production, particularly for the production of single walled carbon nanotubes (SWNT). A secondary commercial application of the innovation will be as a means for the production of hydrogen with extremely low CO contamination for use in fuel cells. The NASA application will be as Flight Hardware for deployment in support of future long duration exploration objectives such as a lunar base, Mars transit or Mars base. The primary application will be for the recovery of hydrogen lost in the Sabatier process for CO2 reduction to produce water in Advanced Life Support systems. Secondarily, this process may also be used in conjunction with a Sabatier reactor employed for propellant and fuel production from Martian atmospheric CO2. This process will also produce carbon nanotubes which may be employed for adsorption or catalytic destruction of toxic airborne or waterborne contaminants.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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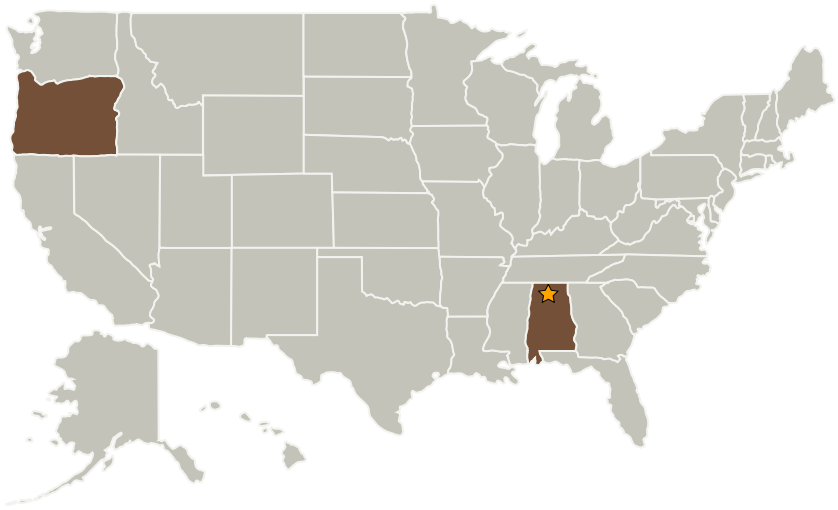
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
UMPQUA Research Company	Supporting Organization	Industry	Myrtle Creek, Oregon

Primary U.S. Work Locations	
Alabama	Oregon

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Project Manager:
Robyn Carrasquillo

Principal Investigator:
James Atwater

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.1 Atmosphere Revitalization